IN THE UNITED STATES PATENT AND TRADE MARK OFFICE

VERIFICATION OF TRANSLATION

I, Michael Wallace Richard Turner, Bachelor of Arts, Chartered Patent Attorney, European Patent Attorney, of 1 Horsefair Mews, Romsey, Hampshire SO51 8JG, England, do hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof;

I verify that the attached English translation is a true and correct translation made by me of the attached specification in the German language of International Application PCT/DE2005/000528;

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: July 31, 2006

M W R Turner

# Security and/or value document

The invention concerns security and/or value documents, for example banknotes, cheques, share certificates, credit cards, software certificates or identity cards or passes, which comprise a support of a paper material with one or more window-shaped openings and a preferably strip-form or thread-form film element.

There is a need for security and/or value documents to be provided with security features which make it difficult to forge those documents and as far as possible to prevent that. It is already known in that respect for security and/or value documents to be provided with transmissive security elements which can be checked when viewed in a transillumination mode and which afford a particularly high level of security against imitation by means of a colour copier.

It has already been proposed in that respect for security threads to be introduced into value documents, which are exposed in region-wise manner at the surface in order to be able to check additional security elements on the thread, for example print patterns, diffraction structures and so forth. Thus for example EP-A-0229645 describes the production of a security paper with an incorporated security element in the form of a thread in which two separate layers of paper are formed, which have regions of smaller thickness or openings. The two paper layers are brought together and the band which serves as a security element is introduced during the operation of bringing them together. In that situation the arrangement can also be so selected that the openings in the two paper layers are in mutually superposed coincident relationship so that the security element is exposed at the same location on the paper web on both sides. That also permits the security element to be viewed in the transillumination mode.

That approach however suffers from the disadvantage that, as security threads must be incorporated into the paper web they may only be of comparatively narrow width in order not to interfere with the paper in

itself being held together. That is the case in particular if the paper web is exposed in coincident relationship on both sides in order to permit a security element to be viewed in a transillumination mode. In addition it is necessary here to use security threads of relatively large thickness so that the security threads afford adequate tensile strength in spite of their small width. That thickening effect which occurs in a relatively narrow region results in poor planar positioning of the sheets and thus gives rise to problems in further processing of the value document.

In addition DE-A-4334847 describes a value document in which window-shaped openings are subsequently produced in the support of the value document by means of a stamping or cutting operation. Those openings are then closed by means of a cover film which is transparent at least in region-wise manner and which projects beyond the openings on all sides and which is fixed on the surface of the support over the full area thereof. That arrangement makes it possible to use a cover film which has one or more security elements and which is of comparatively large dimensions so that, in comparison with the above-described windows which are produced in production of the paper, it is possible to implement larger windows and the thickness of the film element can be reduced. In terms of practical implementation of that procedure however it has been found that here too with relatively large window widths, problems can occur in further processing of the security and/or value documents.

The invention is now based on the object of proposing a security and/or value document which is suitable for the use of security elements which can be checked in a transillumination mode, and can be subjected to further processing without any problem.

That object is attained by a security and/or value document which comprises a support of a paper material with one or more window-shaped openings and an in particular strip-form or thread-form film element with one or more optical security features, wherein the one or more window-shaped openings are closed by means of the film element which projects beyond the openings on all sides, and a sealing layer which covers the surface of the film element at least in the region of the openings is applied

to the side of the support of a paper material, which is in opposite relationship to the film element.

In that respect the invention is directed in particular to film elements and/or sealing layers which do not completely cover the two sides of the paper support so that the paper support, besides temperature influences, is accordingly also exposed to further environmental influences such as moisture. In that situation the film element covers a side of the paper support preferably up to a maximum of 50% of its area, in particular up to a maximum of 20% of its area. Preferably the film element is of such a nature in terms of its area extent that the spacing between the edge of the film element fixed on the paper support and an edge of the opening, which is at the shortest spacing in relation thereto, corresponds at maximum to the length, width or diameter of the respective opening, but preferably corresponds at a maximum to 50% of the length, width or diameter of the respective opening.

The invention is based on the realisation that, when the window-shaped openings of the paper support are closed by means of the film element, the specific material properties of the paper material from which the support is made can lead to problems in terms of further processing of the security and/or value document. Thus the expansion characteristics of the paper material are both dependent on moisture, the fibre direction of the paper material and the temperature. As the openings in the support of a paper material are closed by means of a film element, the expansion characteristics of which differ greatly from those of the paper support, influences in further processing, for example moisture or changes in temperature, can seriously worsen the result of the further processing procedure. The later use of the finished security and/or value document can also be adversely affected. It is here that the invention provides a remedy: the sealing layer provides that the openings are stabilised at the rear side so that further processing of the security and/or value document can be effected with the available technologies. Further advantages are also enjoyed in subsequent use of the security and/or value document as there too temperature and moisture influences have low levels of influence

on the appearance of the security and/or value document. The invention makes it possible for the width of security elements which are suitable for transillumination, in conjunction with the advantages of paper as the support material, to be further increased and thus make it possible to further increase the safeguard against forgery of security and/or value documents.

Advantageous configurations of the invention are recited in the appendant claims.

In accordance with a preferred embodiment of the invention the sealing layer covers the surface area of the film element at least to 80%. Stabilisation of the film element at its rear side over a full area in that way substantially prevents moisture from penetrating into the paper support, whereby the expansion characteristics of the paper support are substantially influenced. In addition that provides for mechanical compensation and adjustment in relation to the film element, whereby the occurrence of bulge configurations is made more difficult.

Further advantages are afforded if the area of the sealing layer is between 100 and 120% of the area of the film element. That affords on the one hand tolerances for application of the sealing layer in accurate register relationship and on the other hand that avoids disadvantageously influencing the processing procedure due to an excessively large sealing layer.

It is desirable for the sealing layer to be transparent so that it does not influence the graphic configuration of the security and/or value document.

The forgery-proofness of the security and/or value document can be further improved if the sealing layer and/or the film element is at least region-wise overprinted with a print. That provides that changes to the film element or the sealing layer, for example removal of the film element, become immediately visible. Such overprinting, for example by means of steel intaglio printing, leads to a strong influence in respect of the temperature and moisture conditions to which the security and/or value

document is exposed so that the result here is greatly improved by the use of the invention.

In accordance with a preferred embodiment of the invention the sealing layer comprises a lacquer layer which is preferably applied to the paper support by printing in a thickness of about 2 to 10 µm. In particular a screen printing process, preferably printing by means of a flat screen, is appropriate here as the printing process. In this respect particularly good results can be achieved when applying by printing a relatively thick lacquer layer in the range of 2 to 10 µm. Such a lacquer layer reliably prevents the ingress of moisture and has the necessary thickness to act as a "counterweight" for the expansion characteristics of the film element. Preferably the thickness of the lacquer layer and the composition thereof are so selected that the lacquer layer is approximately of an expansion coefficient which corresponds to that of the film element. That makes it possible to almost completely prevent bulges being formed.

In this respect the term "expansion coefficient" is used to denote on the one hand the thermal length expansion coefficient $\alpha$ (linear thermal expansion coefficient). Upon a change in temperature in the region of the window-shaped opening in the support the lengths of the film element and the sealing layer change in dependence on the respective material used for forming them. If therefore upon a change in temperature the film element expands or shrinks to a greater degree than the sealing layer, that results in unwanted bulging in the region of the window-shaped opening.

On the other hand the term "expansion coefficient" further means expandability of the film element and the sealing layer which is predetermined by way of the material-dependent modulus of elasticity E or the inverse thereof, the expansion value 1/E. Upon a mechanical loading applied to the film element and the sealing layer in the region of the window-shaped opening, for example due to folding, bending, creasing or the like, the materials are deformed in dependence on their modulus of elasticity, in which case the fact of exceeding the elasticity limit of a material leads to permanent deformation. If now with substantially the same amount of force being applied to the film element and the sealing

layer, for example the elasticity limit of the film element is exceeded earlier than that of the sealing layer, then the film element is plastically deformed while the sealing layer which is only elastically deformed tries to return to its initial state. That results in unwanted permanent bulges which can be avoided when the modulus of elasticity of the film element is matched to that of the sealing layer.

In accordance with a further preferred embodiment of the invention the sealing layer is produced by means of a film which is counter-laminated in register relationship, preferably a cold or hot stamping film which is counter-laminated in register relationship. In that case the counter-laminated film preferably comprises a lacquer layer and an adhesive layer, the thickness of the lacquer layer preferably being in the range of about 2 to 10 µm, for the reasons already specified hereinbefore. In addition it is also possible for the counter-laminated film used to be a film comprising an adhesive layer and a film body, for example a PET film of a thickness of 12 to 16 µm.

It is particularly preferred in that respect if the counter-laminated film has an expansion coefficient which approximately corresponds to that of the film element. As already described hereinbefore in relation to use of a lacquer layer as the sealing layer, the term expansion coefficient is used on the one hand to denote the length expansion coefficient and on the other hand the modulus of elasticity.

In general it has proven to be advantageous if the sealing layer has an expansion coefficient which approximately corresponds to that of the film element, in particular the expansion coefficient corresponding to a length expansion coefficient or a modulus of elasticity.

In that respect it has proven to be advantageous if the sealing layer has a length expansion coefficient which differs from a length expansion coefficient of the film element by not more than 10%, preferably not more than 5%. Upon a change in temperature therefore the sealing layer experiences approximately the same change in length as the film element so that no or substantially no bulging in the region of the window-shaped opening of the support occurs. That is found to be particularly

advantageous in particular when stacking for example banknotes or when subjecting the support to further processing in an automated process in which a flat surface is required, for example in the printing operation, stamping operation or the like.

It is further preferable if the sealing layer has a modulus of elasticity which differs from that of the film element by not more than 10%, preferably not more than 5%. Such a configuration for the film element and the sealing layer permits optimum handling of the finished security or value document. Banknotes are usually also mechanically stressed in the region of the window-shaped openings, for example by folding. In the event of defect matching of the modulus of elasticity of the sealing layer to that of the film element, that can result in permanent bulges which on the one hand result in optical impairment of the banknote and which on the other hand can lead to technical errors and faults in automatic cash machines.

The invention is described by way of example hereinafter by means of a number of embodiments with reference to the accompanying drawings in which:

Figure 1 shows a diagrammatic representation of a value document according to the invention,

Figure 2 shows a diagrammatic representation of a section through the value document of Figure 1,

Figure 3 shows a detail view of a film element which is used in the value document of Figure 2,

Figure 4 shows a diagrammatic representation of a section through a value document according to the invention in accordance with a further embodiment thereof, and

Figure 5 shows a diagrammatic representation of a section through a value document according to the invention in accordance with a further embodiment thereof.

The value document shown in Figure 1 represents a banknote. It is however also possible for that value document to represent a cheque, a

traveller's cheque, a share certificate or software certificate, a security document, for example an identity card or pass or the like.

The value document shown in Figure 1 has a support 1 of a paper material. The paper material is preferably a paper quality which is used for banknotes and which can be provided in known manner with water marks, special printing thereon and other security elements. Such further security elements comprise for example steel intaglio printing, microprinting or a reflective security feature, for example a hologram or a colour change element.

The support 1 of a paper material is preferably of a thickness of about 100 µm. The support 1 is normally part of a paper web or a paper sheet in production of the value document, value documents as shown in Figure 1 being cut out of the part of the paper web or sheet after it is finished.

As shown in Figure 1 the support 1 has a plurality of window-like openings 31 to 36. Those window-like openings can be arranged in any arrangement and configuration in the region of a film element 2. In this case before application of the film element 2 the openings 31 to 36 are produced in the paper sheet by means of a stamping or cutting operation, preferably by means of conventional stamping processes, or by means of laser or water jet cutting. Prior to application of the film element 2 however it is also possible to shape a depression in the region of the surface 2 to which the film element 2 is to be applied, by means of an embossing or stamping tool, with the film element then being laid in the depression. By virtue of the production of a depression of that nature, the thickness of the value document 1 can be reduced, the paper material is smoothed, and subsequent detachment of the film element is made more difficult.

The film element 2 is preferably of a strip-shaped or thread-shaped form, preferably with a strip width in the region 4 to 30 mm. Preferably in that case the film element 2 extends transversely over the entire width or length of the support 1, thereby simplifying application of the film element 2 from the point of view of production engineering.

Figure 2 shows a section through a partial region of the value document shown in Figure 1, in the region of the openings 35. Figure 2 shows the support 1, the film element 2 with a decorative layer 22 and a support film 21 as well as a sealing layer 4 which extends over the region of the opening 35.

As shown in Figures 1 and 2, the window-like opening 35 is closed by means of the film element 2, wherein the film element 2 is fixed on the surface of the support 1 over the full area thereof by means of an adhesive layer in such a way that the film element is firmly fixed on the surface of the support and projects beyond the window-like openings 31 to 36 on all sides so that the film element 2 adheres fixedly to the surface of the support 1 around the openings 31 to 36. As shown in Figure 2 in that case the film element 2 is preferably fixed on the paper material of the support 1 by using heat and pressure, for example by means of a special stamping roller, by the adhesive layer being activated by the heat and the pressure. At the same time, a depression is produced in the region of the film element by the pressure applied, thereby achieving the advantages already outlined above. It is however also possible for the film element 2 to be applied to the paper material by means of a cold stamping process and the adhesive layer can be for example an adhesive which can be hardened by means of UV radiation or a cold-hardening, pressure-sensitive adhesive.

The structure of the film element 2 will now be described by way of example with reference to Figure 3.

Figure 3 shows the film element 2 with a transparent carrier film 21 and the decorative layer 22.

The carrier film 21 comprises a PET or BOPP film of a layer thickness of 10 to 50 µm. In this respect the function of the carrier film 21 is to provide the necessary stability for bridging over the openings 31 to 36 so that the thickness which is preferably to be selected for the support film 21 is substantially determined by the width of the openings 31 to 36. In that respect, with a suitable choice for the layers of the decorative layer 22 and the sealing layer 4, it is however also possible for the composite assembly

of those layers to already have the necessary mechanical stability so that it is possible to dispense with the support film 21.

In the embodiment shown in Figure 3 the decorative layer 22 has a bonding layer 23, a first lacquer layer 24, an optical separation layer 25 and an adhesive layer 26.

The bonding layer 23 is of a thickness in the region of 0.2 to 2 µm and is applied to the support film 21 by means of a printing process. Under some circumstances it is also possible to dispense with the bonding layer 23 if adequate adhesion between the support film 21 and the first lacquer layer 24 is already achieved or if the support film 21 is dispensed with.

The first lacquer layer 24 is a replication lacquer layer comprising a thermoplastic or cross-linked polymer in which a diffractive structure 27 is replicated by means of a replicating tool, under the action of heat and pressure.

By way of example the lacquer used for the first lacquer layer 24 can be a lacquer of the following composition, which is applied over the entire surface area with a weight in relation to surface area of about 2.2 g/m$^2$ after drying:

| Composition: | Proportions by weight: |
|---|---|
| High-molecular PMMA resin | 2000 |
| Silicone alkyd oil-free | 300 |
| Non-ionic wetting agent | 50 |
| Low-viscosity nitrocellulose | 750 |
| Methyl ethyl ketone | 4200 |
| Toluene | 2000 |
| Diacetone alcohol | 2500 |

After drying of the lacquer, for example in a drying passage at a temperature of 100 to 120°C, the diffractive structure 27 is produced by embossing by means of a stamping die.

The optical separation layer 25 is then applied to the first lacquer layer 24. The optical separation layer 24 can in this case involve a transparent material which is markedly different in its refractive index from the refractive index of the lacquer layer 24 so that the diffractive structure

27 provides a transparent security feature. It is also possible for a metal layer to be applied to the first lacquer layer 24 partially or over the full surface area, as the optical separation layer 25.

The material used for such a metal layer can be for example aluminium, chromium, gold or silver or an alloy of those metals. In that case the metallisation is preferably applied to the first lacquer layer 24 by means of vapour deposition or sputtering. Instead of a metallisation it is also possible for an HRI or LRI layer (HRI = high refraction index; LRI = low refraction index) to be applied to the first lacquer layer 24 partially or over the full surface area.

The HRI or LRI layer preferably comprises a suitable dielectric, for example $TiO_2$ or ZnS (for HRI) or $MgF_2$ (for LRI).

In the region of the opening 35 the diffractive structure 27 generates a transmissive security element which has an optical-diffraction effect, for example a hologram or kinegram. In that respect it is also possible to implement one or more of the following security features in the decorative layer 22, instead of the above-described security feature or in addition to that security feature, in the region of the opening 35:

In the region of the opening 35, it is possible to provide a thin-film layer system or a colour layer with thin-film layer pigments or a cholesteric liquid crystal material, which generate a viewing angle-dependent colour shift effect and thus afford the viewer a colour change element, as the security feature. Such a thin-film layer system for example comprises a layer composite with an absorption layer, a $\lambda/2$ layer as a spacer layer and a layer whose refractive index differs from that of the spacer layer. It is however also possible for a thin-film layer system of that kind to be made up of a succession of high-refractive and low-refractive layers, for example three to nine or two to ten such layers. The higher the number of layers, the correspondingly sharper is it possible to set the wavelength for the colour change effect. Examples of usual layer thicknesses for the individual layers of such thin-film layer systems and examples of materials which in principle can be used for the layers of such a thin-film layer system are disclosed for example in WO 01/03945, page 5, line 30 to page 8, line 5.

In the region of the opening 35 the decorative layer 22 can further have a polarisation layer comprising for example a layer of oriented and cross-linked liquid crystal polymers. That provides a further security feature in the region of the opening 35.

The decorative layer 22 can further have one or more colour layers which have luminescent and in particular UV or IR fluorescent pigments which are arranged for example in pattern form and which can serve as a further security feature.

The decorative layer 22 can also have one or more colour layers with a security printing, for example a microscript, or one or more layers which are demetallised in pattern form and which constitute a further security feature in the region of the opening 35.

It is possible in that respect to implement any combinations of the above-described security features in the region of the opening 35 in the decorative layer 22.

The adhesive layer 26 is of a thickness in the region of 5 to 6 µm and comprises a thermally activatable adhesive. By way of example an adhesive of the following composition can be used for the adhesive layer 26:

| Composition: | | Proportions by weight: |
|---|---|---|
| Toluene | | 2000 g |
| Acetone | | 2100 g |
| High-molecular ethyl methacrylate | Tg 60°C | 300 g |
| Methacrylate copolymer | Tg 40 – 80°C | 700 g |
| Thermoplastic polyvinylacetate | Tg 80 – 83°C | 200 g |
| Ethanol | | 2100 g |
| Highly-dispersed silicic acid | | 100 g |

That adhesive is applied for example with a line raster with 60 l/cm and an application weight of 5 – 6 g/m$^2$ to the subjacent layer of the decorative layer portion 22.

On the side of the support 1 which is in opposite relationship to the film element 2, a sealing layer 4 is applied by means of a printing process in the region of the film element 2, after fixing of the film element 2.

It is of particular significance in that respect that the sealing layer 4 is applied to the side of the support 1 which is in opposite relationship to the film element 2, at least in the region of the openings 31 to 36 of the carrier 1, after closure of those openings by means of the film element 2. Applying the sealing layer 4 in that region provides that the cut edges of the paper support 1 are sealed off in relation to the penetration of moisture thereinto, the adhesive layer, which is still exposed, of the film element 2 is sealed and the window-shaped openings are mechanically stabilised.

As shown in Figure 2 it is further advantageous for the sealing layer 4 to be applied to the side of the support 1 which is in opposite relationship to the film element 2, in a region which slightly overlaps the region of the film element 2, and thus in the entire region of the film element 2 to provide for mechanical stabilisation and sealing of the paper material in relation to moisture penetrating thereinto.

The sealing layer 4 can be applied to the support 1 by printing, pouring, scattering or sprinkling or spraying. Preferably the operation of applying the sealing layer 4 is effected by means of a screen printing process as relatively thick lacquer layers can be applied to the support 1 with a sufficient degree of accuracy by means of such a process. So that the sealing layer 4 can form a mechanical counterpart to the film element 2, a certain thickness is required for the lacquer layer. The sealing layer 4 therefore comprises a lacquer layer of a thickness of 2 to 10 µm, the expansion coefficient of which approximately corresponds to that of the film element 2. In that way it is possible substantially to avoid bulge formation in the region of the film element 2 upon a change in the environmental conditions such as moisture and temperature or mechanical loading.

In principle the lacquer used for forming the sealing layer 4 can be solvent-bearing two-component lacquer, aqueous dispersions and UV lacquer with a high proportion of solids. The lacquer used for the sealing layer 4 can in that respect be a transparent lacquer or also a coloured lacquer. It is also possible for the sealing layer 4 to be composed of prints of different colours, which for example each run out in a respective half-tone. In addition the lacquer used for the sealing layer 4 should be an

overprintable lacquer, that is to say a lacquer which is not too excessively cross-linked so that printing ink can adhere thereto.

Thus by way of example a lacquer of the following composition is used as the lacquer for the sealing layer 4:

| Composition: | | Proportions by weight: |
|---|---|---|
| Cyclohexanone | | 2800 g |
| Xylene | | 1400 g |
| Ethylene-vinylacetate copolymer | Tg 65 - 70°C | 100 g |
| PVC copolymer | Tg 75 - 80°C | 500 g |
| PMMA | Tg 115°C | 500 g |
| Highly-dispersed silicic acid | | 50 g |
| Silicone-based anti-foam agent | | 15 g |

That lacquer is applied by printing by means of a flat screen 77 T, coated with direct emulsion, to the support layer 1 in the above-identified thickness range of 2 to 10 µm and with an application weight, by means of which it is possible to achieve a layer thickness in the above-indicated layer thickness range.

After hardening or cross-linking of the lacquer of the sealing layer 4 the sealing layer 4 and/or the film element 2 is overprinted at least in region-wise manner, thereby providing a further increase in security. In that case the overprinting operation is preferably effected by means of die stamping.

Further embodiments by way of example of the invention will now be described with reference to Figures 4 and 5, in which the sealing layer 4 is formed by a counter-laminated film.

Figure 4 shows the support 1, the film element 2 with the support film 21 and the decorative layer 22, the opening 35 and a sealing layer 5 which comprises a counter-laminated film comprising a support film 52 and an adhesive layer 51.

The support 1 and the film element 2 are shaped as described with reference to Figures 1 to 3.

The adhesive layer 51 comprises an adhesive which can be activated by pressure or heat or also a UV hardenable adhesive. By way of example

the adhesive layer 51 is formed by the adhesive used for the adhesive layer 26 of the film element 2 shown in Figure 3.

The film 5 is preferably prefabricated in the manner of a hot or cold stamping film and then laminated onto the side in opposite relationship to the film element 2, using pressure and heat or using pressure and UV radiation.

The support film 5 is a transparent PET or BOPP film of a layer thickness in the region of 12 to 16 µm.

In the embodiment shown in Figure 5, instead of the film 5, a film 6 is applied to the side of the support 1 which is in opposite relationship to the film element. The film 6 comprises an adhesive layer 61 and a protective lacquer layer 62 which is preferably of a thickness in the region of 2 to 12 µm. The film 6 is preferably applied to the support 1 as part of a transfer layer of a cold or hot stamping film. The adhesives used for the adhesive layer 26 of the film element 2 can be used as the adhesive for the adhesive layer 61.

The protective lacquer layer 62 is transparent and can be for example of the following composition:

| Composition: | Proportions by weight: |
|---|---|
| Methyl ethyl ketone | 300 |
| Ethyl acetate | 170 |
| Cyclohexanone | 100 |
| Hydroxy-functional acrylate (60% in xylene/EPA, OH index 140) | 200 |
| Cellulose nitrate (low viscosity, 65% in alcohol) | 80 |
| Aromatic isocyanate (50% in ethyl acetate, NCO content 8%) | 150 |

In that respect it is also possible for a bonding layer further to be applied to the support film 62 of the film 5 or to the protective lacquer layer 62 of the film 6, the bonding layer facilitating subsequent overprinting of the sealing layer.